

1                   METHOD AND SYSTEM FOR HIGH-SPEED  
2                   TABLET COUNTING AND DISPENSING

3

4                This application is a continuation-in-part of U.S.  
5    Serial No. 10/430,117, filed on May 6, 2003, which is a  
6    continuation-in-part of 09/975,608, filed October 11, 2001,  
7    each incorporated by reference herein in its entirety.

8

9                   BACKGROUND OF THE INVENTION

10

11    1. Field of the Invention

12        This invention relates broadly to medicament tablet  
13    counting and dispensing apparatus. More particularly, this  
14    invention relates to tablet feeding and counting apparatus  
15    which are adapted to dispense any selected number of  
16    tablets, up to a maximum number, with minimal dispensing  
17    delay.

18

19    2. State of the Art

20        In retail, hospital, and mail order medication  
21    dispensing, a large number of different prescriptions of  
22    single dose medications, such as tablets, must be filled.  
23    (Hereinafter, reference to "tablets" should be understood

1 for purposes herein as being generic to tablets, capsules,  
2 caplets and any other solid dose medication).

3

4 Larger quantity prescriptions are often filled with  
5 the aid of a counting apparatus intended to more rapidly  
6 count different quantities of different tablets  
7 successively. For example, a prescription for ninety  
8 tablets of 10 mg Claritin® may need to be filled after a  
9 prescription for sixty tablets of 400 mg Motrin®.

10

11 With an automatic tablet counter, the pharmacist  
12 obtains a bulk container of a prescription medication from  
13 a shelf and then pours from the container a quantity of  
14 tablets into a hopper of the counting apparatus. The  
15 pharmacist then sets the counting apparatus to the number  
16 of tablets to be counted, e.g., ninety. Assuming at least  
17 the required number of tablets for the prescription has  
18 been poured into the hopper, the pharmacist waits while the  
19 counting apparatus counts the required number of tablets  
20 and dispenses the tablets into a patient prescription  
21 bottle. The excess tablets are discharged back into the  
22 bulk container, which is then replaced on the shelf. It  
23 has been found that the time taken to discharge the excess

1 tablets can be equal to or greater than the time required  
2 to count the prescription.

3

4 Each prescription medication must be obtained from a  
5 bulk storage container located in stock, which must be  
6 opened prior to use and closed after use. In order to  
7 minimize the time taken to dispense a prescription, counter  
8 manufacturers have provided "cassette counters" for retail,  
9 hospital, and mail order pharmacies. Each cassette is  
10 designed for a specific size and shape capsule, tablet, or  
11 caplet. The cassettes are pre-filled by the pharmacist  
12 with bulk quantities of the appropriate prescription drugs,  
13 and are used to store bulk quantities rather than using the  
14 container supplied by the manufacturer. The prescription  
15 medication is then dispensed directly from the cassette.

16 The use of cassettes eliminates the time needed to open the  
17 manufacturer's original container, the time needed to  
18 return excess tablets to the container, and the time needed  
19 to close the container.

20

21 However, there are situations, particularly in bulk  
22 mail order pharmacies and high volume hospital dispensing,  
23 where greater dispensing speed is desired than is currently

1 provided by automatic dispensing systems, particularly for  
2 the most frequently dispensed medications.

3

## 4 SUMMARY OF THE INVENTION

5

6 It is therefore an object of the invention to provide  
7 a system for dispensing a selected quantity of tablets  
8 extremely rapidly, irrespective of the type of tablet and  
9 the quantity of tablets dispensed.

10

11 It is another object of the invention to provide a  
12 system for dispensing tablets which functions with all  
13 tablets regardless of size, shape, and weight.

14

15 It is an additional object of the invention to provide  
16 a system for dispensing tablets which is not prone to  
17 clogging.

18

19 It is a further object of the invention to provide a  
20 system for dispensing tablets which is efficient.

21

22 In accord with these objects, which will be discussed  
23 in detail below, a system and method for storing and

1 dispensing discrete objects, such as 'tablets' (stated  
2 above to be generic for tablets, capsules, caplets and any  
3 other solid dose medication), is provided and adapted to  
4 dispense a number of tablets, up to a maximum number,  
5 without a delay associated with counting the tablets.

6

7 The system and methodology include first counting and  
8 storing a preset number of tablets in respective dedicated  
9 chambers (storage locations), the combination of the  
10 numbers of tablets within the chambers being useful for  
11 dispensing commonly prescribed numbers of tablets.

12

13 According to one embodiment of the invention, n  
14 chambers are provided, with  $2^0, 2^1, 2^2, \dots, 2^{n-1}$  tablets  
15 provided respectively in the individual chambers. Using  
16 such a system, any number of tablets, up to the additive  
17 combination of all the chambers (e.g., where n=7, the  
18 additive combination is 127), can be dispensed from the  
19 chambers by selectively emptying the chambers which  
20 together add up to the selected number for dispensing.

21

22

1       Because the number of tablets in each of the chambers  
2    is always the same, the system optionally can be hardwired  
3    to select the tablets from the required chambers without  
4    any combinatorial computation process; i.e., for any number  
5    of tablets selected for dispensing, there always exists a  
6    particular readily determinable combination of chambers  
7    which can be emptied to comprise the selected number of  
8    tablets exactly. Alternatively, the chambers can be  
9    selected by a simple computational process; i.e., first  
10   identifying the chamber having the largest number of  
11   tablets less than the selected number for dispensing, then  
12   identifying the chamber having the next largest number of  
13   tablets, provided that the addition of such number of  
14   tablets to the previously identified chamber does not  
15   exceed the selected number for dispensing, then identifying  
16   the chamber having the next largest number of tablets,  
17   provided that the addition of such number of tablets to the  
18   previously identified chambers does not exceed the selected  
19   number for dispensing, etc., until the desired number of  
20   tablets has been identified. As each chamber is  
21   identified, or after all have been identified, the exit  
22   gates are released, preferably in succession, to dispense  
23   the tablets.

1       According to another embodiment of the invention,  
2    there are n chambers, where n preferably equals at least  
3    four, and the number of tablets in a particular chamber i  
4    is preferably  $2^{i+2}$ , where  $i = 1 \dots n$ . In accord with this  
5    embodiment, a direct feed channel is provided in addition  
6    to the chambers. The direct feed channel feeds  
7    individually counted tablets into an exit chute in  
8    combination with the tablets dispensed from the chambers.  
9    The direct feed channel is primarily provided for counting  
10   up to  $2^{i+2}-1$  tablets, where i preferably equals one, e.g.,  
11   seven tablets. As such, the direct feed channel in  
12   combination with the chambers permits dispensing of any  
13   number of tablets up to  $\sum_{i=1}^n 2^{i+2} + 7$ ; e.g. where n=4, up to 127  
14   tablets. However, it is certainly appreciated that the  
15   chambers may store a non-exponentially incremented number  
16   of tablets, and that the direct feed channel may be used to  
17   supply up to another number of tablets.  
18  
19       After the selected chambers are emptied tablets are  
20    fed from a feeder which stores bulk quantities of the  
21    tablet, counted, and directed into the emptied chambers to  
22    refill the chambers with the preset number of tables. The

1 direction of the tablets into the emptied chambers for  
2 filling is preferably controlled by refill gates which open  
3 to receive or direct the required number of tablets and  
4 close once appropriately refilled. It is appreciated that  
5 only those chambers which are emptied after dispensing need  
6 to be refilled and, as such, only the number of tablets in  
7 those storage locations need to be counted.

8

9 According to another aspect of the invention, each  
10 chamber  $i$  may include subchambers which are each filled  
11 with the appropriate number of tablets for the chamber.  
12 Then, when activated, a subchamber of the chamber is  
13 emptied. The remaining filled subchambers are then ready  
14 for subsequent dispensing while the emptied subchamber is  
15 being refilled. As such, the user is not required to wait  
16 before attempting to dispense another prescription for the  
17 tablets. Moreover, during a single dispensing operation  
18 more than one subchamber of a chamber may be emptied,  
19 particularly when large numbers of tablets are to be  
20 dispensed.

21

22 In addition, an overflow chamber may be provided for  
23 extra tablets which are inadvertently fed into the refill

1 system after the required count to fill one or more of the  
2 chambers has been met. A count is kept of the tablets in  
3 the overflow chamber, and the overflow chamber is emptied  
4 during the subsequent dispensing or when the number therein  
5 is suitable in combination with one or more other chambers  
6 to meet an input number of tablets for dispensing.

7

8 The system may include a plurality of cells, each  
9 including a plurality of chambers for a different solid  
10 dose medication. The solid dose medication may then be  
11 selected along with the number of tablets required to be  
12 dispensed.

13

14 Additional objects and advantages of the invention  
15 will become apparent to those skilled in the art upon  
16 reference to the detailed description taken in conjunction  
17 with the provided figures.

18

## 1 BRIEF DESCRIPTION OF THE DRAWINGS

2

3 Fig. 1 is a schematic view of a medicament tablet  
4 counting and dispensing system according to the invention  
5 including a cell provided with chambers having tablets;

6

7 Figs. 2, 3 and 4 are schematic views of the tablet  
8 counting and dispensing system of Fig. 1, showing a  
9 sequence for release and closure of exit gates;

10

11 Figs. 5, 6 and 7 are schematic views of the tablet  
12 counting and dispensing system of Fig. 1, showing a  
13 sequence for opening and closure of refill gates;

14

15 Fig. 8 is a schematic section of a side elevation view  
16 of a first embodiment of a multi-cell tablet counting and  
17 dispensing system;

18

19 Fig. 9 is a schematic section view through line 9-9 in  
20 Fig. 8;

21

22 Fig. 10 is a schematic view of a second embodiment of  
23 a multi-cell tablet counting and dispensing system;

1

2       Fig. 11 is a perspective view of another embodiment of  
3       an tablet counting and dispensing system according to the  
4       invention; and

5

6       Fig. 12 is a schematic view of the system of Fig. 11.

7

8       Fig. 13 is a flow chart illustrating control  
9       operations in loading tablets into a subchamber of the  
10      tablet counting and dispensing system of Figs. 11 and 12.

11

12      DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

13

14       Turning now to Fig. 1, a tablet dispensing system 10  
15      is shown which includes a hopper 12 which stores a bulk  
16      quantity of tablets, a feeder 14 which feeds tablets from  
17      the hopper 12 to a cell 16, which is described in more  
18      detail below, a counter 18 which counts the tablets fed by  
19      the feeder to the cell 16, and a controller 34 which  
20      operates the cell 16 and permits a user to enter or select  
21      the number of tablets to be dispensed.

22

1        The hopper 12, feeder 14 and counter 18 may be of any  
2        type known in the art suitable for counting small discrete  
3        objects, such as tablets. For example, the hopper 12 and  
4        feeder 14 may be a vibratory bowl feeder, a mechanical  
5        feeder, or a cassette system such as described in co-  
6        pending U.S. Ser. No. 09/871,531, filed May 31, 2001, which  
7        is hereby incorporated by reference herein in its entirety,  
8        each of which may have an integrated unit which functions  
9        as both a hopper and a feeder. The counter 18 is  
10      preferably an optical system which uses an optical sensor  
11      array, such as that disclosed in co-owned U.S. Patent No.  
12      5,768,327, which is hereby incorporated by reference herein  
13      in its entirety. The optical sensor array of U.S. Patent  
14      No. 5,768,327 includes an orthogonal arrangement of two  
15      discrete optical sensors which together sense objects in  
16      three dimensions. This sensor arrangement is adapted to  
17      sense multiple objects simultaneously falling past the  
18      sensors.

19

20        The cell 16 includes a plurality of vertically-stacked  
21      inclined chambers (storage locations) 20 positioned below  
22      the counter 18. Seven chambers sequentially numbered one  
23      through seven are shown in the embodiment of Fig. 1. The

1 chambers 20 each have a fill gate 22 and an exit gate 24.  
2 When the fill gate 22 of any chamber is open, that chamber  
3 is in communication with a feed chute 26 and thereby  
4 adapted to receive tablets 28 fed from the feeder 14 and  
5 counted by the counter 18. With the respective exit gates  
6 24 closed, each chamber 20 stores a predetermined, and  
7 preferably different, number of tablets. As discussed in  
8 more detail below, when the exit gate 24 of any chamber is  
9 in an open position, the tablets stored within the chamber  
10 20 are released into an exit chute 30, and from the exit  
11 chute 30 the tablets are dispensed into a container 32.  
12 The fill gates and exit gates are preferably  
13 electromechanically controlled, e.g., with solenoids  
14 powered by the controller 34, to effect movement of the  
15 gates between open and closed positions.

16

17 The combination of the numbers of tablets within the  
18 plurality of chambers 20 is capable of comprising any  
19 number of tablets which is desired for dispensing.  
20 According to a preferred system, n chambers are provided,  
21 with  $2^0$ ,  $2^1$ ,  $2^2$ , ...,  $2^{n-1}$  tablets provided respectively in  
22 the individual chambers 20. Using such a system, any  
23 number of tablets, up to the additive combination of all

1 the chambers (e.g., where n=8, the additive combination is  
2 255), can be dispensed by selectively emptying the chambers  
3 which together add up to the selected number for  
4 dispensing.

5

6 As shown in Fig. 1, in an embodiment of the invention,  
7 seven chambers 20 are provided; i.e., n=7. The chambers  
8 are provided with tablets as follows: chamber one includes  
9 one tablet ( $2^0$ ); chamber two includes two tablets ( $2^1$ );  
10 chamber three includes four tablets ( $2^2$ ); chamber four  
11 includes eight tablets ( $2^3$ ); chamber five includes sixteen  
12 tablets ( $2^4$ ); chamber six includes thirty-two tablets ( $2^5$ );  
13 and chamber seven includes sixty-four tablets ( $2^6$ ).

14

15 Referring to Fig. 2, if it is desired to dispense,  
16 e.g., twenty-six tablets, twenty-six tablets are selected  
17 at the controller 34 which causes the exit gates 24 of  
18 chambers two, four and five to be opened. The gates may be  
19 opened simultaneously. However, in the embodiment of the  
20 invention as shown, where the gates swing open, the gates  
21 are preferably opened in succession and at time intervals,  
22 e.g., 0.25 seconds between each opening, starting with the  
23 gate of the lowermost chamber. The time interval prevents

1 jamming by the tablets. As the exit gates are opened, the  
2 tablets in the respective chambers (two, eight, and sixteen  
3 tablets, respectively) are released into the exit chute 30.  
4 The sixteen tablets from chamber five fall directly into  
5 the container, while the tablets from chambers four and two  
6 are retained the open exit gates of chambers five and four  
7 respectively. Referring to Fig. 3, the exit gates 24 are  
8 then closed from the bottom up, preferably again in  
9 succession and at a short time interval, to release the  
10 retained tablets into the chute 30 for dispensing. That  
11 is, when the exit gate 24 of chamber five is closed, the  
12 tablets from chamber four which were resting on that gate  
13 are released to fall through the exit chute 30 and into the  
14 container. Likewise, when the exit gate 24 of chamber four  
15 is closed, the two tablets retainer from chamber two fall  
16 into the container 32. Referring to Fig. 4, the exit gate  
17 24 of chamber two, previously holding the two tablets is  
18 then closed.

19

20 As is discussed hereinafter, because the number of  
21 tablets in each of the particular chambers 20 is kept  
22 constant (due to refilling), the system optionally can be  
23 hardwired at the controller 34 to open the exit gates from

1 the required chambers without any combinatorial computation  
2 process; i.e., for any number of tablets selected for  
3 dispensing, there always exists a particular readily  
4 determinable combination of chambers which can be emptied  
5 to comprise the selected number of tablets exactly, up to  
6 the maximum number of tablets stored in the cell 16.

7

8       Alternatively, the chambers can be selected by a  
9 simple computational process performed by the controller  
10 34, for example, by first identifying the chamber having  
11 the largest number of tablets less than the selected number  
12 for dispensing, then identifying the chamber having the  
13 next largest number of tablets, provided that the addition  
14 of such number of tablets to the previously identified  
15 chamber does not exceed the selected number for dispensing,  
16 then identifying the chamber having the next largest number  
17 of tablets, provided that the addition of such number of  
18 tablets to the previously identified chambers does not  
19 exceed the selected number for dispensing, etc., until the  
20 desired number of tablets has been identified. As each  
21 chamber is identified, or after all have been identified,  
22 the exit gates are opened and closed, preferably in  
23 succession as described above, to dispense the tablets.

1

2       The tablet dispensing system requires no tablet  
3       counting time because the chambers of the cell are  
4       preloaded. The only time required is for the gates to open  
5       to release and empty the tablets from the identified  
6       chambers. While time is required to refill the emptied  
7       chambers, the refill occurs after dispensing and presumably  
8       while the system operator is completing the prescription  
9       requirement (e.g., labeling, data entry, packaging, etc.)  
10      or identifying and/or preparing the subsequent prescription  
11      information; i.e., refill occurs during system operator  
12      downtime.

13

14       After the identified chambers have been emptied, such  
15      chambers need to be refilled for subsequent dispensing  
16      operations. Referring now to Fig. 5, the fill gates 22 of  
17      the emptied chambers (chambers two, four, and five in the  
18      example) are opened, and the tablets 28 are fed by the  
19      feeder 14 from the hopper 12 to the counter 18 (which is  
20      preferably an optical counter such as disclosed in co-owned  
21      U.S. Patent #5,768,327). Once the counter counts the  
22      required number of tablets for the uppermost emptied  
23      chamber (chamber two), and after a short predetermined

1 delay to permit the tablets to fall through the fill chute  
2 26 to the respective chamber, the fill gate of that chamber  
3 is closed, as shown in Fig. 6. Still referring to Fig. 6,  
4 then the tablets required for the next chamber (i.e.,  
5 chamber four) are counted, enter the fill chute and fall  
6 through the open fill gate to the chamber. Referring to  
7 Fig. 7, once chamber four is refilled, its respective fill  
8 gate 22 is closed, and chamber five is refilled in a like  
9 manner. It is appreciated that only those chambers which  
10 are emptied after dispensing need to be refilled and, as  
11 such, only the number of tablets in those chambers need to  
12 be counted. It is also appreciated that the dispensing  
13 system is initialized by counting and directing the  
14 required number of tablets to each of the respective  
15 chambers.

16

17 Referring to Figs. 8 and 9, a tablet dispensing system  
18 110 may include a plurality of radially arranged cells 116  
19 each including a plurality of chambers 120 for a different  
20 solid dose medication. Each of the cells 116 is preferably  
21 provided with its own hopper 112, feeder 114 and counter  
22 118. The solid dose medication may be selected from a  
23 controller (not shown) along with the number of tablets

1 required to be dispensed. A common exit chute 130 can be  
2 used for dispensing into a bottle or container.

3

4 Turning now to Fig. 10, another embodiment of a multi-  
5 cell tablet dispensing system 210 is shown. Each cell 216  
6 includes its own hopper 212 and preferably a feeder 214. A  
7 common counter 218 may be movable between the hoppers 212,  
8 feeders 214, and the cells 216. Alternatively, the feeder  
9 214 may be integrated with the counter 218 and also movable  
10 relative to the hoppers 212 and cells 216. From the above  
11 multi-cell system embodiments, is understood that various  
12 other configurations of a multi-cell system may be  
13 implemented.

14

15 While the preferred system includes cells with  $n$   
16 chambers provided with  $2^0$ ,  $2^1$ ,  $2^2$ , ...,  $2^{n-1}$  tablets in the  
17 respective chambers, it will be appreciated that chambers  
18 having another arrangement of tablet quantities may be  
19 used, provided that such arrangement permits the desired  
20 number of tablets to be dispensed. It is appreciated that  
21 not every number of tablet need be able to be dispensed,  
22 just those quantities which are generally prescribed.

1 Prescribed quantities are generally in multiples of 7 or  
2 10.

3

4 Turning now to Figs. 11 and 12, another embodiment of  
5 a dispensing system 310 for tablets is shown. The system  
6 310 generally includes many of the features described  
7 above, including a hopper 12, a feeder 14, and a counter  
8 18. The system 310 also includes a cell 316 preferably  
9 having n primary chambers 320 for storing tablets, where n  
10 is preferably greater than or equal to four. The number of  
11 tablets in a particular chamber  $i$  is preferably  $2^{i+2}$ , where  
12  $i = 1 \dots n$ . Thus, for exactly four chambers 320, according  
13 to a presently preferred embodiment, a first chamber 320a  
14 preferably includes eight tablets, a second chamber 320b  
15 preferably includes sixteen tablets, a third chamber 320c  
16 preferably includes 32 tablets, and a fourth chamber 320d  
17 preferably includes 64 tablets. The cell 316 preferably  
18 also includes a fifth chamber 320e, the purpose of which is  
19 described further below. With four primary chambers, the  
20 chambers are adapted to dispense a large range of numbers  
21 of tablets, between 8 and 120 tablets, and even up to 240  
22 using multiple chambers and double dispensing, as discussed  
23 below.

1

2       A direct feed channel 340 is provided in addition to  
3       the cell 316. The direct feed channel 340 provides  
4       automatic feed-through of individually counted tablets in a  
5       manner which bypasses the chambers 320 of the cell 316.

6       The direct feed channel 340 is primarily provided for  
7       counting up to the number of tablets stored in the cell  
8       chamber having the fewest number of tablets. For example,  
9       if the first chamber 320a stores eight tablets, the direct  
10      feed channel 340 is provided for automatically feeding up  
11      to seven tablets into the chute 330. As such, for n=4, the  
12      chambers 320 in combination with the direct feed channel

13      340 permit dispensing of any number of tablets up to  $\sum_{i=1}^n 2^{i+2} + 7$

14      (i.e., 127 tablets), without requiring three additional  
15      chambers for 1 ( $2^0$ ), 2 ( $2^1$ ) and 4 ( $2^2$ ) tablets, as in the  
16      prior embodiments. Moreover, there is no need to direct  
17      feed more tablets than already pre-counted and stored in a  
18      chamber.

19

20       According to a preferred aspect of the invention, each  
21       chamber 320 preferably includes a plurality of subchambers,  
22       such as 342, 344, 346. Each of the subchambers 342, 344,

1 346 can be provided with the respective number of tablets  
2 for that chamber 320. That is, if a chamber 320 is  
3 designated to dispense eight tablets at a time, then each  
4 of the subchambers 342, 344, 346 is preferably provided  
5 with eight tablets, though it is appreciated that at any  
6 given time one or two of the subchambers may be emptied of  
7 tablets and awaiting refill. In a preferred embodiment,  
8 the chambers 320 are generally circular, with the  
9 subchambers 342, 344, 346 defined by sectors formed by  
10 radially extending walls 348 located 120° apart about a  
11 central hub 350. The chambers 320 are preferably mounted  
12 for individual mechanical rotational movement by a  
13 motorized actuation mechanism 352. The circumference of  
14 each circular chamber 320 includes a rim 353 which  
15 preferably extends within a stationary guide 355 at the  
16 bottom of the gateway 360, described below, to facilitate  
17 rotational alignment of the chambers 320. The chambers 320  
18 also include an outer wall 354 provided with openings 356  
19 into each of the subchambers. An enclosure 358, shown in  
20 broken lines, is provided partially about the cell 316 to  
21 retain tablets in the subchambers 342, 344, 346 and limit  
22 release of the tablets within the subchambers. The  
23 enclosure 358 has upper and lower apertures (not shown)

1 which permit tablets to be received into the chamber and  
2 dispensed therefrom. When a subchamber is oriented in a  
3 first direction, e.g., vertically upwards, the subchamber  
4 is positioned to receive tablets fed through its opening  
5 via the gateway 360. When a subchamber is oriented  
6 vertically downwards, the subchamber is oriented to empty  
7 its tablet contents via its opening 356 into the chute 330.  
8 When a subchamber is oriented such that its opening is not  
9 adjacent the gateway 360 or chute 330, the subchamber and  
10 enclosure 358 merely store tablet contents.

11

12 Upon receiving an input for dispensing a certain  
13 number of tablets, the necessary chambers to comprise the  
14 largest number of tablets smaller than the input number are  
15 actuated, e.g., by rotation, to empty their contents.  
16 Alternatively, all chambers are rotated and only the  
17 necessary chambers (or subchambers) are emptied, e.g., by  
18 providing actuatable gates at the openings to the  
19 subchambers. If necessary, tablets are automatically fed  
20 into the direct feed channel 340 to complete the required  
21 number of tablets. For example, if an input is received to  
22 dispense ninety tablets, the fourth, second and first  
23 chambers are rotated to empty eighty-eight (64+16+8)

1 tablets, and the direct feed provides an additional two  
2 tablets, for a total of ninety tablets.

3

4 According to another aspect of the invention, it may  
5 be desirable to be able to dispense a relatively large  
6 number of tablets by emptying more than one subchamber of a  
7 chamber. For example, if the number of tablets input for  
8 dispensing is one hundred-eighty, and the cell includes  
9 four primary chambers, each with three subchambers, of  
10 which two such subchambers of each chamber are preferably  
11 filled at any one time, the cell may be actuated to release  
12 two subchambers, each with sixty-four tablets from the  
13 fourth chamber 320d, one subchamber with thirty-two tablets  
14 from the third chamber 320c, and one subchamber of sixteen  
15 tablets from the second chamber 320b. Four tablets  
16 automatically fed from the feeder 14 to the direct feed  
17 channel 340 complete the request.

18

19 After a dispensing operation, tablets are fed from the  
20 feeder through the gateway 360 to the appropriate chambers  
21 for subchamber refilling. The gateway 360 is a series of  
22 channels including the above described direct feed channel  
23 340 and chamber channels 364, 366, 368, 370 which direct

1 tablets from a funnel 372 below the feeder 14 and into the  
2 chambers 320a-e. Appropriate channels 340, 364, 366, 368,  
3 370 are selected by operation of a plurality of actuatable  
4 gates 374. The gates 374 are movable between opened and  
5 closed positions to, at any given time, define a single  
6 path for a tablet from the funnel 372 to one of the  
7 channels 340, 364, 366, 368, 370. This permits subchambers  
8 to be refilled with the designated number of tablets after  
9 a dispensing operation, as well as the output of individual  
10 tablets through the direct feed channel 340.

11

12 After a subchamber is filled with the appropriate  
13 number of tablets, it is possible that an additional tablet  
14 will have already been fed by the feeder 14 to the counter  
15 18, but not yet counted. As such, after filling a chamber,  
16 the gates 374 move to a default position whereby such an  
17 extra tablet is provided to the fifth chamber 320e. The  
18 fifth chamber 320e operates as a temporary repository for  
19 such tablets. Generally, no more than one extra tablet  
20 would be counted per chamber. As such, with four chambers,  
21 up to four tablets may be provided to the fifth chamber  
22 upon each refill of the chambers. A count is kept of the  
23 tablets in the fifth chamber 320e, and the tablets in the

1 fifth chamber are preferably dispensed along with the  
2 tablets in other appropriate chambers (i) when the number  
3 in the fifth chamber 320e is suitable in combination with  
4 one or more other chambers 320a, 320b, 320c, 320d to meet  
5 an input number of tablets for dispensing, or (ii) during  
6 every dispensing in combination with one or more other  
7 chambers and an appropriate number of tablets provided  
8 through the direct feed channel 340. Emptying the fifth  
9 chamber 320e whenever tablets are stored therein,  
10 regardless of how many tablets are in the fifth chamber,  
11 prevents inadvertent storage of a relatively large number  
12 of tablets which may be difficult to dispense in  
13 combination with the other chambers 320a-d.

14

15 In the above embodiment, it is recognized that the  
16 first chamber may be set to have more than eight tablets  
17 and that direct feed may be used for more than seven  
18 tablets. Moreover, while the chambers have been described  
19 as having exponentially incremented numbers of tablets, it  
20 is appreciated that it may be desirable to fill the  
21 chambers with numbers of tablets which are multiples of  
22 seven and/or ten, in view of the fact that most  
23 prescriptions comprise a number of tablets in a multiple of

1 seven or ten. Moreover, the number of tablets designated  
2 for a particular chamber can be altered via software or  
3 hardware.

4

5 Fig. 13 is a flow chart that illustrates the  
6 operations performed by a controller to load tablets into a  
7 given subchamber *i* within the chambers 320a-e. It will be  
8 appreciated that this process is readily extended to load  
9 tablets into each subchamber within the chambers 320a-e,  
10 and can be used to initially load tablets into the  
11 subchambers as well as reload tablets into a subchamber  
12 after it has been emptied as described below. The  
13 operations begin in block B301 wherein the controller  
14 determines whether the subchamber *i* is empty and thus  
15 requires reloading of tablets. If not, the operation  
16 returns to wait until this condition is satisfied. If so,  
17 the operations continue to blocks B303 and B305. In block  
18 B303, the controller controls actuation of the gates of the  
19 feed channel (via electrical signals supplied thereto) to  
20 define a feed path from the counter to the circular chamber  
21 that includes subchamber *i*. It also controls rotation of  
22 this circular chamber (via electrical signals supplied to  
23 actuation mechanism 352) such that subchamber *i* is oriented

1 vertically and tablets supplied thereto will pass through  
2 the opening in the outside wall of the circular chamber  
3 into the subchamber *i*. In block B305, the controller  
4 starts the feed of tablets into the counter and into the  
5 feed channel to initiate the fill operation for the  
6 subchamber *i*. The operations then continue to block B307.

7

8 In block B307, the controller monitors the count value  
9 output by the counter to determine whether this count value  
10 is less than the desired count value (which is the number  
11 of tablets to be loaded into the subchamber *i*). When this  
12 operation fails (the count value output by the counter is  
13 equal to the desired count value), the operations continue  
14 to blocks B309 and B311.

15

16 In block B309, the controller terminates the feed of  
17 tablets into the counter and into the feed channel to  
18 terminate the fill operation for the subchamber *i*.

19

20 In block B311, the controller controls actuation of  
21 the gates of the feed channel (via electrical signals  
22 supplied thereto) to define a feed path from the counter to  
23 the fifth chamber 320e (e.g., overflow chamber), thereby

1 removing the supply path to the subchamber *i*. This  
2 terminates the fill operation for subchamber *i* after  
3 loading the desired number of tablets into the subchamber  
4 *i*. Any extra tablets that may be fed into the counter are  
5 stored in the fifth chamber 320e (e.g., overflow chamber).

6

7 It will be appreciated that the circular chambers  
8 320a-e as described above provide logical groups of tablet  
9 storage containers (e.g., the group of three subchambers  
10 that make up a given circular chamber), wherein each group  
11 is associated with a given number of tablets. This feature  
12 enables high speed dispensing operations by selectively  
13 emptying one or more of the tablet storage containers that  
14 has been filled with the associated number of tablets.

15

16 In the exemplary embodiments described above, only one  
17 of the storage containers of a particular group is filled at  
18 a time, and one or more of the storage containers of the  
19 particular group is emptied at a time. These features  
20 provide for simple and efficient operation. Moreover, it is  
21 preferred that one of the storage containers of a particular  
22 group be capable of being filled simultaneously while  
23 another storage container of the particular group is  
24 emptied. This feature provides for decreased delays in  
25 filling the storage containers that would otherwise result

1 in the event that such operations are performed  
2 sequentially.

3

4 It will be appreciated that the multi-chamber cell 316  
5 as described above may be readily adapted for use in a  
6 multi-cell tablet dispensing system (Fig. 10). In this  
7 configuration, the cell is realized by a multi-chamber cell  
8 316 and supporting elements as described above with respect  
9 to Figs. 11 through 13. From the above multi-cell system  
10 embodiments, is understood that various other  
11 configurations of a multi-cell system may be implemented.

12

13 There have been described and illustrated herein  
14 several embodiments of a tablet dispensing system and a  
15 method of dispensing tablets. While particular embodiments  
16 of the invention have been described, it is not intended  
17 that the invention be limited thereto, as it is intended  
18 that the invention be as broad in scope as the art will  
19 allow and that the specification be read likewise. Thus,  
20 while the gates may be operated with a solenoid, it is  
21 appreciated that other means for moving the gates may be  
22 used. Also, while swinging gates have been disclosed, it  
23 will be appreciated that other types of gates can be

1 utilized. In fact, if vertical space is provided between  
2 chambers, vertically moving gates may be utilized, and, in  
3 some embodiments, when vertically moving gates are  
4 utilized, all gates may be opened simultaneously, and all  
5 tablets may be dispensed immediately. In addition, while a  
6 particular number of chambers have been shown in each cell,  
7 it will be understood that other numbers of chambers may be  
8 used. Moreover, in one embodiment, while the number of  
9 tablets in each of the chambers is shown to increase with  
10 the successively lower located chambers, it is understood  
11 that the number of tablets designated for the chambers can  
12 be otherwise organized, e.g., a decreasing number of  
13 tablets as the chambers are located lower, or with another  
14 order to the number of tablets in relation to the location  
15 of the chambers. In addition, while a controller is shown,  
16 it is appreciated that the controller may comprise two or  
17 more discrete systems; e.g., a system which permits user  
18 input, a system which controls gate operation, a system  
19 which controls the feeder, and a system which communicates  
20 with the object counter to turn off the feeder once the  
21 required number of tablets have been counted. Also, while  
22 the system is described with respect to dispensing tablets,  
23 it will be appreciated that the system and method apply to

1 the dispensing of other relatively small discrete objects.  
2 Furthermore, aspects of one embodiment may be combined with  
3 aspects of another embodiment. It will therefore be  
4 appreciated by those skilled in the art that yet other  
5 modifications could be made to the provided invention  
6 without deviating from its spirit and scope as claimed.

7